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(12) UK Patent Application (19) GB (11) 2 250 930 (13) A

(43) Date of A publication 24.06.1992

(21) Application No 9126959.7

(22) Date of filing 19.12.1991

(30) Priority data
(31) 9017338 (32) 20.12.1990 (33) DE

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(51) INT CL[5]
B02C 19/18, B01F 11/02

(52) UK CL (Edition K)
B2A A55
B1C CAEB C102 C630 C654 C664
U1S S1025 S1032 S1433

(56) Documents cited
None

(58) Field of search
UK CL (Edition K) B1C, B2A A55
INT CL[5] B20C

(54) **Flow vessel for a disintegrator**

(57) The flow vessel has a housing 14 forming a cavity 26 a connection 21 which seals the cavity and a bar-shaped sonotrode 3 projecting into the cavity which sonotrode is connected to an acoustic transducer which transmits its oscillations to the medium to be processed the connection 21 having a borehole 23 connected to an inlet 4, the borehole 23 opening out into the cavity 26 opposite the end of the sonotrode 3 and connection 21 being adjustable in order to optimise efficiency and to set a defined distance to the sonotrode 3.

Horn 13 which transmits oscillations to sonotrode 3 has recesses (28, 29 figure 4) to prevent transmission of oscillations to jacket 15.

Cooling medium can flow round jacket 15.

Figures 5–7 illustrate forms of sonotrodes.

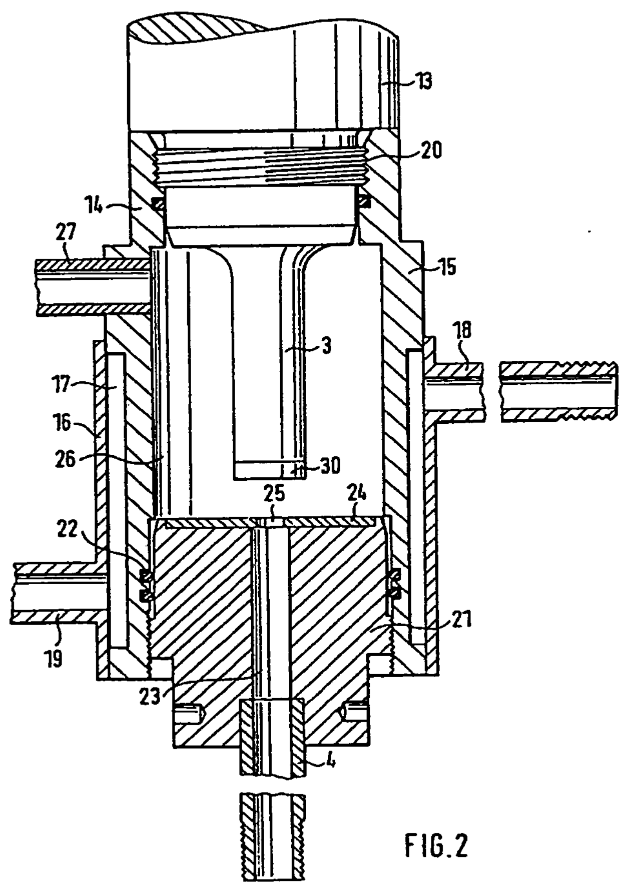

FIG.2

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

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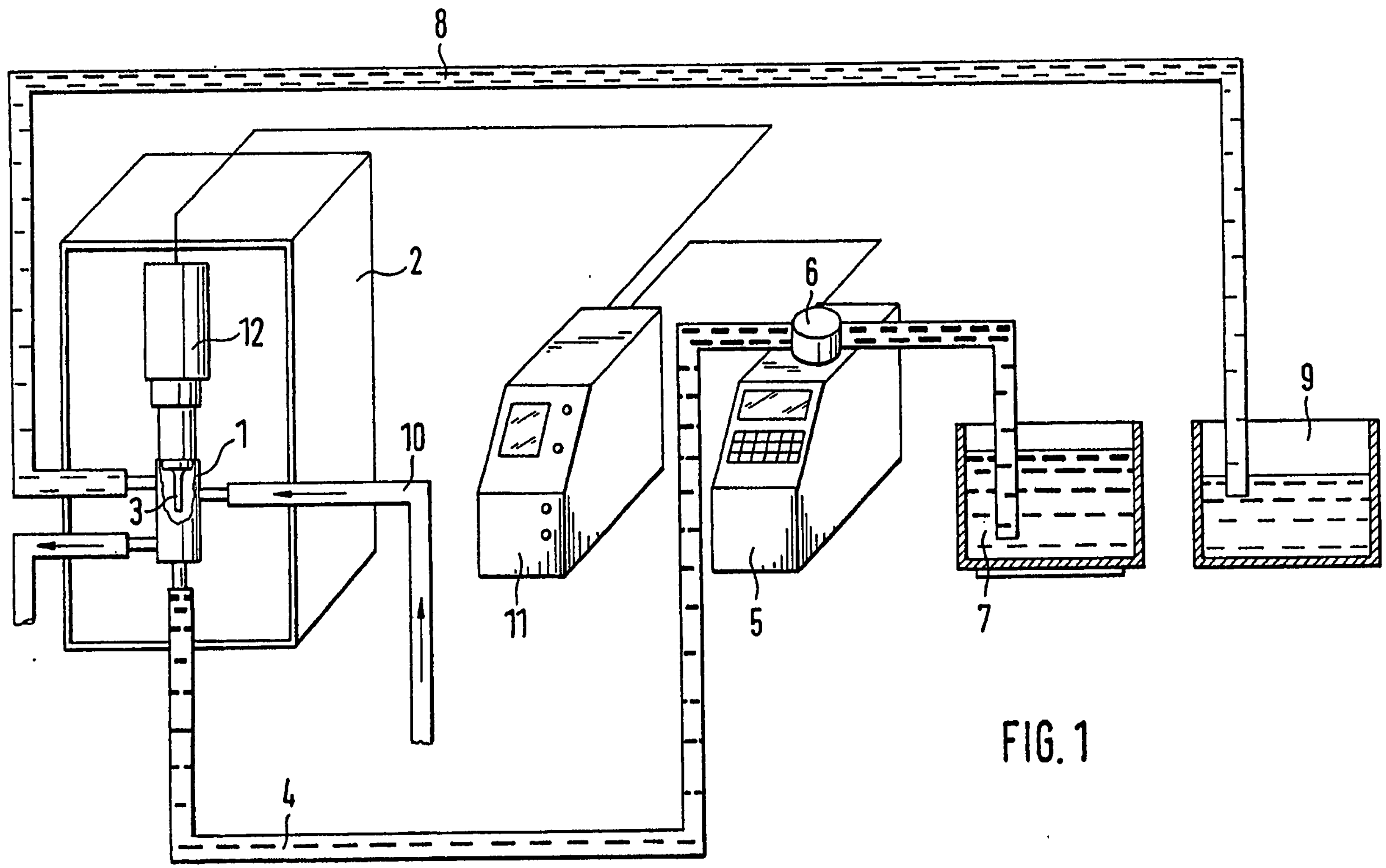


FIG. 1

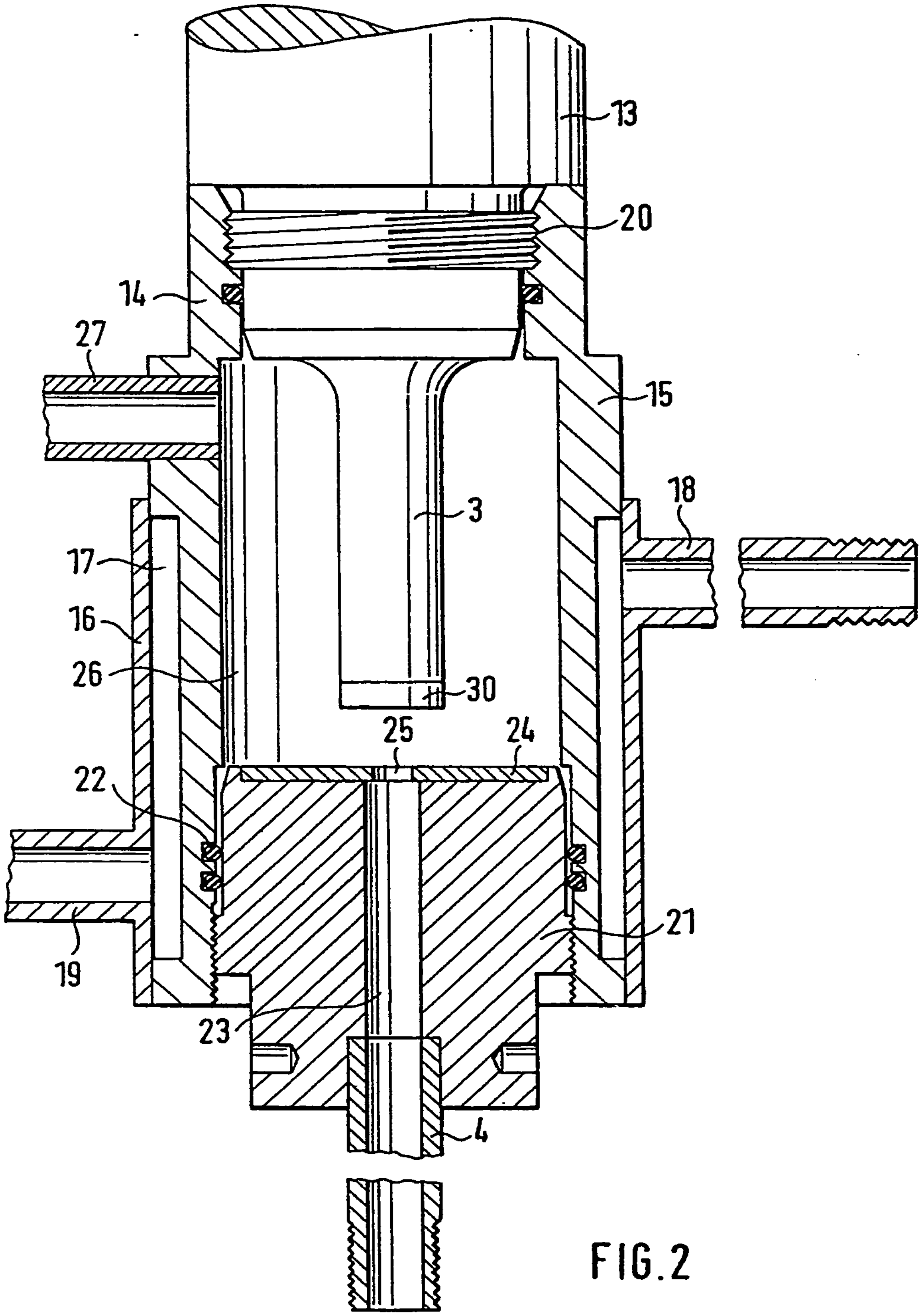


FIG.2

FIG.3

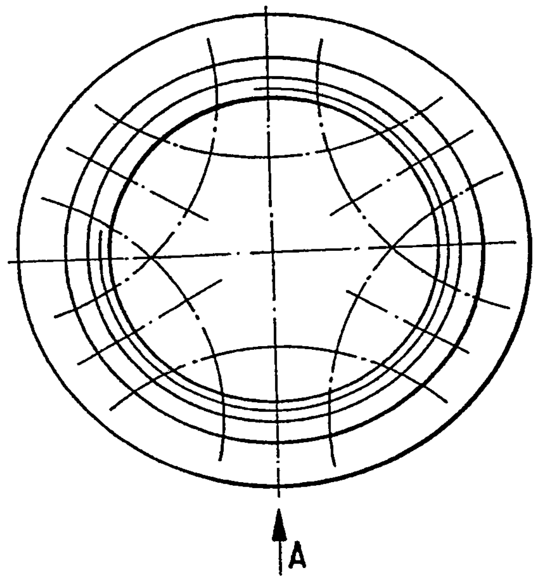


FIG.4

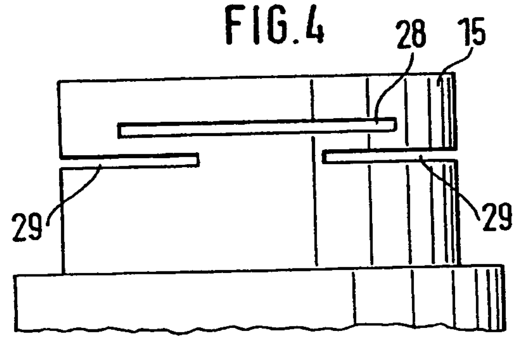


FIG.5

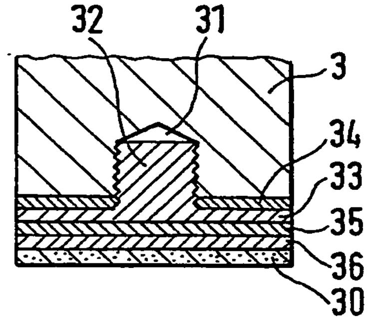


FIG.6

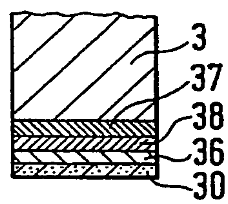
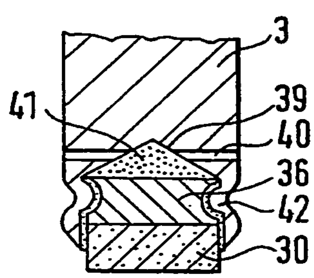


FIG.7



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Flow vessel for a disintegrator

The invention relates to a flow vessel for a disintegrator.

Disintegrators are used, for example, in medicine for breaking up cells, bacteria and fungi and in industry for homogenising sewage, manufacturing emulsions, dispersing powders in liquids and for dispersing agglomerates in biology. To do this, a flow vessels is used into which a sonotrode designed as an ultrasonic transducer dips with the medium to be processed flowing through the flow vessel. The sonotrode is excited to produce high-frequency oscillations by an acoustic transducer which is connected to a high-frequency generator. To achieve good efficiency and a maximum of energy the position of the sonotrode in the flow vessels must normally be adjusted such that defined distances are maintained between the end of the sonotrode and a deflector plate

facing it.

The object of the invention is to create a flow vessel for a disintegrator which flow vessel enables the efficiency to be controlled and the medium to be processed to be supplied with a maximum of energy.

This object is achieved as per invention by the distinguishing features of the main claim. Because a flow connection facing the end of the sonotrode is provided with a deflector plate which is vertically adjustable it is possible to control the efficiency and also to restrict the space between the sonotrode and the deflector plate opposite such that a maximum of energy can be transmitted to the medium to be processed. As a result, adjustment is simple even in the case of a modified sonotrode.

Advantageous further developments and improvements are possible through the measures described in the sub-claims. The fact that a decoupling of the oscillations from the housing is possible due to the recesses in the area of attachment of the sonotrode to the housing is particularly advantageous. Furthermore, it is particularly advantageous that both the end of the sonotrode and the deflector plate are provided with a anti-cavitation layer of polycrystalline diamond, as damage due to cavitation is then considerably reduced. In this way, disintegrators can be optimally set as the sonotrodes need to be changed less frequently and high output can be achieved, the improved use of continuous processes for processing different types of media being made possible.

Example embodiments of the invention are shown in the drawing and are described in more detail in the following specification.

Fig. 1 is a block diagram of a device for processing a liquid, for example the stabilising of a dispersion, using a disintegrator with a flow vessel as per invention,

Fig. 2 is a section through an example embodiment of a flow vessel,

Fig. 3 is a plan view of the upper section of the housing of the vessel with the sectional course of the recesses,

Fig. 4 is a lateral view of the upper section of the housing according to Fig. 3 with recesses for oscillation decoupling,

Fig. 5 is a partial section through the sonotrode used in the flow vessel as per invention,

Fig. 6 is a partial section of a second example embodiment of a sonotrode used in the flow vessel as per invention, and

Fig. 7 is a partial section through a third example embodiment of the sonotrode used in the flow vessel as per invention.

Fig. 1 shows the flow vessel 1 as per invention with a sonotrode 3 dipping into the flow vessel 1. The flow vessel 1 is connected to a storage container 7 via a supply conduit 4 and a valve 6 controlled by a microprocessor 5. A discharge conduit 8 leads from the flow vessel 1 to a storage tank 9. Furthermore, a cooling circuit conduit 10 is connected to the flow vessel 1 which conduit serves to cool the vessel. An acoustic transducer 12 supplied by a high-frequency generator 11 generates oscillations which are transmitted to the sonotrode 3 via a horn 13 with the sonotrode transmitting the oscillations in the form of axial oscillations to the medium flowing through the flow vessel 1.

In the storage container 7 is, for example, an emulsion to be stabilised. The microprocessor 5 controls the flow rate via the valve 6, the emulsion reaching the flow vessel 1 via the supply conduit 4. In the area beneath the sonotrode 3 the emulsion phases are homogenised due to the pressure waves and after processing the processed emulsion reaches the storage tank 9 via the discharge conduit 8. The flow can be controlled both continuously and discontinuously by the microprocessor 5 although processing remains constant.

Fig. 2 is a section through the flow vessel. The housing 14 of the flow vessel 1 consists of a jacket 15 and a pipe 16 connected to the jacket 15, the jacket 15 having projections at the points of attachment with the pipe 16 such that an annular passage 17 is created between jacket 15 and pipe 16. The pipe 16 has an inlet 18 and an outlet 19 which are connected with the cooling conduit

10 and with the annular passage 17 so that the cooling medium can flow round the jacket 15 of the flow vessel 1 in the annular passage 17. In the upper end of the housing 14 is inserted the bar-shaped sonotrode 3, which forms a unit with the horn 13, and which is screwed via a thread 20 to the housing. A flow connection 21 is screwed into the jacket 15 from below with seals 22 in the form of annular seals being provided to form a seal between jacket 15 and flow connection 21. The flow connection 21 has a central bore hole 23 which is connected with the inlet conduit 4. A deflector plate 24, which has a central bore hole 25 and which faces the end of the sonotrode 3, is inserted in the upper area of the flow connection 21.

The flow connection 21 is vertically adjustable, i.e. the depth to which it can be scewed into the housing, i.e. the jacket, is variable. In this way the distance to the end of

the sonotrode 3 can be set such that a maximum of energy can be supplied via the bore hole 23 to the cavity 26 formed in the housing. The effective processing area of the medium lies between sonotrode 3 and deflector plate 24. A flow connection 27 is connected with the discharge conduit 8.

So that the horn 13 does not transmit any oscillations to the jacket 14 of the housing measures are provided for oscillation decoupling in accordance with Figs. 3 and 4. The two figures refer to the upper area of the jacket 15 into which the horn 13 is screwed with the sonotrode. It can be seen from Fig. 4 that the jacket 15 is provided with recesses 28, 29 at varying heights. Fig. 3 shows the sectional course of the saw discs for the recesses 28, 29 at various heights.

The sonotrode 3 and the horn 13 are preferably made of titanium or a titanium alloy, the end of the sonotrode having an anti-cavitation layer 30. This anti-cavitation layer is shown in greater detail in several example embodiments in Figs. 5, 6 and 7. A pocket bore hole 31 with a thread is incorporated in the end of the sonotrode 3 into which thread the thread connection 32 of a dish 33 is screwed, an organic film or organic layer or a ductile metal sheet which acts as a damping layer 34 to damp radial oscillations being fitted between the end of the sonotrode 3 and dish 33. It has been shown that the connection by screwing of different combinations of materials, titanium and steel for example, out of which the dish 33 is preferably made, creates difficulties at large amplitudes and power densities such as occur in disintegrators. When the sonotrode 3 is excited both axial oscillations and radially-running dilatational waves occur which vary in size due

to the different types of material. As a result, friction occurs between the surfaces which are screwed together which leads to wear and to oscillation decoupling of sonotrode 3 and the screwed dish. Due to the damping layer 34 arranged between sonotrode 3 and dish 33 the radial waves are damped, whilst the axial oscillations are transmitted unimpaired to the dish 33. The damping layer 34 has a thickness of preferably approximately 25 to 75 um.

The anti-cavitation layer 30 which is made of polycrystalline diamond sintered onto the base 36, is connected with the dish 33 with a base 36 inserted in between by hard solder 35 which has a melting temperature of < 750°C.

In Fig. 6 the anti-cavitation layer 30 made of polycrystalline diamond with the base 36 of hard metal is soldered directly to the end of the sonotrode 3, the soldering process

taking place under vacuum or using inert gas using a hard solder 37 combined with the titanium, which hard solder has a melting temperature of > 800°C, and a hard solder 38 applied on top which has a melting temperature of < 750°C.

Fig. 7 shows an example embodiment which is particularly suitable for small diameters of the sonotrode 3, preferably for diameters of 1 mm to 3 mm. A pocket bore hole 39 is made in the end of the sonotrode 3 and, in addition, a very small lateral bore hole 40, for example with a diameter of 0.1 mm to 0.3 mm, provided, which lateral bore hole is connected with the pocket bore hole. Adhesives, preferably epoxy resin, are introduced into the pocket bore hole 39 and the base 36 with the anti-cavitation layer 30 made of polycrystalline diamond is pressed into the bore hole 39 filled with epoxy resin. In doing so, the excess adhesive is pressed into the lateral bore hole 40 and runs out

where appropriate. The remaining side 42 of the sonotrode 3 is provided with a bead which form-fits into a groove set in the hard metal 36. Because the edge of the sonotrode remains free from cavitation due to physical conditions no wear occurs there.

Patent claims

1. Flow vessel for a disintegrator with a housing which presents an inlet and an outlet through which the medium to be processed flows into and out of a cavity provided in the housing with a connection which can be inserted in the housing and which seals the cavity and with a bar-shaped sonotrode projecting into the cavity of the housing which sonotrode is connected to an acoustic transducer which transmits its oscillations to the medium characterised in that the connection is designed as a flow connection (21) with a borehole (23) connected to the inlet (4), the borehole (23) opening out into the cavity (26) opposite the end of the sonotrode (3) and in that the flow connection (21) is adjustable in order to optimise efficiency and to set a defined distance to the sonotrode (3).

2. Flow vessel according to Claim 1 characterised in that in the area of attachment of the sonotrode (3) the housing (11) is provided with recesses (28, 29) for the purposes of oscillation decoupling.

3. Flow vessel according to Claim 1 or 2 characterised in that a deflector plate (24) is arranged between flow connection (21) and the end of the sonotrode (3).

4. Flow vessel according to one of the Claims 1 to 3 characterised in that the housing (14) has a double wall with a gap (17) in the double wall through which gap a cooling medium flows.

5. Flow vessel according to one of the Claims 1 to 4 characterised in that the oscillating end of the sonotrode (3) and the deflector plate (24) are provided with an anti-cavitation layer (30) made of polycrystalline diamond applied to a metal base (35).

6. Flow vessel according to Claim 5 characterised in that the metal base (36) of the anti-cavitation layer (30) is connected by hard soldering to a metal dish (33), the dish (33) being screwed into the end of the sonotrode (3).

7. Flow vessel according to Claim 5 or 6 characterised in that a damping layer (34) is arranged between the end of the sonotrode (3) and the dish (33).

8. Flow vessel according to Claim 7 characterised in that the damping layer (34) is an organic layer, an organic film or a ductile metal sheet.

9. Flow vessel according to Claim 5 characterised in that the metal base (33) of the anti-cavitation layer (30) is directly connected to the end of the sonotrode (3) containing titanium by hard soldering under a vacuum or using an inert gas.

10. Flow vessel according to Claim 5 characterised in that the end of the sonotrode (3) has a pocket borehole (39) into which the anti-cavitation layer (30) with metal base (36) is glued, the wall (42) of the pocket borehole (39) containing a bead which form-fits into a groove set in the hard metal (36).

11. Flow vessel according to Claim 10 characterised in that the pocket borehole (39) is connected with a lateral borehole (40) which serves as a receptacle and a discharge for the adhesive (41).

Patents Act 1977
Examiner's report to the Comptroller under Section 17 (The Search Report)

Application number

9126959.7

Relevant Technical fields

(i) UK Cl (Edition K) B2A (A55);B1C

(ii) Int Cl (Edition 5) B02C

Databases (see over)

(i) UK Patent Office

(ii)

Search Examiner

J M WORVELL

Date of Search

5 FEBRUARY 1992

Documents considered relevant following a search in respect of claims 1-11

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
	NONE	

Category	Identity of document and relevant passages	Relevant to claim(s)

Categories of documents

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